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GRICULTURAL NEWS LETTER

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This publication gives information on new developments of interest to agriculture on laboratory and field investigations of the du Pont Company and its subsidiary companies.

In addition to reporting results of the investigations of the Company and its subsidiaries, published reports and direct contributions of investigators of agricultural experiment stations and other institutions are given dealing with the Company's products and other subjects of agricultural interest.

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AGRICULTURAL NEWS LETTER

Vol. 5 - No. 2 February 1937

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PHENOTHIAZINE AS A CONTROL FOR CODLING MOTH IN THE PACIFIC NORTHWEST GIVES GOOD RESULTS

EDITOR'S NOTE:-The present interest in new and better insecticides is such that the publication of a paper of the character of Mr. Diamond's is certain to attract the attention of all concerned with pest control.

By V. R. Diamond, Entomologist,
Grasselli Chemicals Department,
E. I. du Pont de Nemours & Co.,
Wilmington, Delaware.

Phenothiazine* as a control for codling moth was tested by the Pest Control Research Section, Grasselli Chemicals Department of the du Pont Company during the 1935 and 1936 seasons in the Wenatchee and Yakima Valleys of Washington State. The results in 1936 in the Yakima Valley, tabulated herewith, are in agreement with the limited tests of 1935 and other tests in western states in showing exceptional promise for use in that region. Fruit from plots sprayed with this new organic product showed a much better return to the grower than adjoining plots of lead arsenate sprayed blocks.

Throughout this experiment every effort was made to keep the test on a thoroughly practical basis. A suitable block of mixed varieties of apples near Yakima was laid out in plots of five trees replicated three times. Applications were applied by the regular equipment and crew of the ranch. Likewise the thinning, picking and grading was done by commercial workers who had no knowledge of the spray applications. Although careful observations were made on all these operations by the writer for recording details, the entire handling of the crop was directed by the grower according to routine practices.

It should be pointed out that the ranch selected for the test had suffered severe losses from codling moth in past seasons. The experimental block was located in the most severely infested region of this ranch.

Although the tabulated records best show the results with phenothiazine, it might be of interest to note its advantages and disadvantages in summarized form. In general the advantages of phenothiazine as shown in these tests are:

1. Superior control of codling moth, especially in the matter of eliminating stings.

2. It eliminates costly and injurious washing methods for removal of residue.

3. Greater value of fruit resulting from greater effectiveness.

Continued on next page

4. There is some evidence of value as a contact insecticide.

Disadvantages brought to light are:

1. Phenothiazine is incompatible with oil.

2. Certain sensitive individuals suffer skin irritation when working with the compound.

3. There is some possibility that phenothiazine may affect size and color of the fruit. This experiment indicates that such effect if any, will probably be relatively unimportant.

WORM CONTROL

Results given below show marked superiority of phenothiazine in control of codling moth larvae. The reduction in "stings" is particularly remarkable. This fact greatly increases the amount of fruit in the Extra Fancy grade in severely infested orchards. Nine applications were made on all plots.

TABLE I

Relative efficiency of Phenothiazine and arsenate of lead in the control of codling moth of apples.

Variety
Rome Beauty

Spray Formula	No. apples Examined	% apples clean	% apples "stung"	% apples wormy
Phenothiazine - 2 lbs. Water - 100 gallons	977	91.7	5.6	5.1
Phenothiazine - 3 lbs. Water - 100 gallons	1048	96.9	2.2	1.0
Lead arsenate - 3 lbs. Herring oil spreader - 1 pt. Water - 100 gallons	1140	55.0	37.9	9.6
Variety Winesap				
Phenothiazine - 2 lbs. Water - 100 gallons	398	91.9	5.2	2.7
Phenothiazine - 3 lbs. Water - 100 gallons	303	97.3	1.6	1.3
Lead arsenate - 3 lbs. Herring oil soap - 1 pt. Water - 100 gallons	376	68.8	31.9	4.5

Continued on next page

Commercial Grade Report

In the case of the Rome Beauty plots there was sufficient fruit to allow commercial grading of fruit from each spray treatment as a separate lot.

The grading was carried out at one of the large packing houses at Yakima, Washington, according to their regular routine.

TABLE 2

Grade classification of apples treated with arsenate of lead and phenothiazine.

Grade Classification	SPRAY FORMULA 'L.A. - 3 lbs. 'H.O.S-1 pt. 'Water-100 gal.	' Phenothiazine ' 2 lbs/100 gal. ' Spreader inc.	' Pehnothiazine ' 3 lbs/100 gals. ' Spreader inc.
Weight of sample graded	5158 lbs.	5141 lbs.	4372 lbs.
EXTRA FANCY GRADE	14.6%	37.9%	39.5%
FANCY GRADE	49.9%	45.0%	44.9%
"C" GRADE	8.3%	2.8%	6.0%
CULLS	27.2%	14.3%	9.6%

CULL ANALYSIS

Worms	31.9%	46.1%	32.9%
Scale	63.9%	40.5%	45.9%
Bruises	2.1%	1.1%	4.7%
Excess stings	3.1%	0.0%	0.0%
Fire injury **	0.0%	6.7%	3.6%
Windfalls	0.0%	1.1%	8.2%

** Caused when adjacent warehouse burned down.

SIZE ANALYSIS

Size of Fruit	Spray Applications Lead A. - 3 lbs. SS-3 - 3 oz. Water -100 gal.	Phenothiazine 2 lbs/100 gal. Spreader inc.	Phenothiazine 3 lbs/100 gal. Spreader inc.
163 and larger	91.8%	94.4%	95.7%
175 and smaller	8.2%	6.6%	4.3%

Continued on next page

COLOR OF FRUIT

Because there has been some evidence reported indicating that phenothiazine may retard coloring of fruit, careful attention was given to this feature. Throughout the season there was no apparent difference in color in the fruit of phenothiazine sprayed plots from that in lead arsenate sprayed plots, and it was not surprising when a special analysis made by an experienced commercial grader showed no appreciable difference in color of the fruit (Rome Beauty variety).

These results on this red variety give some promise that the reduction in color due to phenothiazine may not be of importance. Nine applications of spray were put on this fruit. The apples were held in cold storage from picking time until December 15th before being graded according to the marketing policy of this packing house.

TABLE 3

Color classifications of apples treated with arsenate of lead and phenothiazine.

Spray formula	Size of sample	Extra Fancy Color	Fancy Color	"C" Grade Color
Lead-A.-3 lbs. H.O.S. - 1 pt. Water - 100 gals.	170 lbs.	87.1%	8.8%	4.5%
Phenothiazine 3 lbs/100 gals.	171 lbs.	91.8%	5.3%	2.9%
Phenothiazine 2 lbs/100 gals.	165 lbs.	88.5%	7.9%	3.6%

CONTACT VALUE OF PHENOTHIAZINE

In view of the fact that phenothiazine causes some irritation to the skin of sensitive humans, giving a sensation not unlike sunburn, it was thought that the product might have some contact value in control of certain insects. Results indicate that it retards the building up of aphis colonies and that it may reduce the spread of young scale insects.

From these results it appears that phenothiazine shows excellent promise for western apple growers in the control of codling moth. In this region the product has shown more insecticidal efficiency than any other material ever tested. There is reason to believe that small amounts of residue are harmless to human beings if taken internally. Only simple washing without the use of undesirable high temperatures will be necessary in preparing the fruit for market. There is, however, need for further study of the product under varied conditions. The effect on trees or fruit, the irritation to the skin of sensitive individuals and the matter of compatibilities with other materials and improved adhesive agents will be given special study during the 1937 season.

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* Phenothiazine (thiodiphenylamine) has been patented by Euclid W. Bousquet of the E. I. du Pont de Nemours & Co., through Canadian Industries, Ltd. (Can. 362,024). Patents are pending in the United States by the Grasselli Chemicals Dept.

THE NITROGEN FERTILIZATION OF TOBACCO -A SUMMARY OF CONNECTICUT EXPERIMENTS

EDITOR'S NOTE:- There is presented here for the first time a rather complete summary of the results of extensive experiments carried on over a term of years. This summary will be available in booklet form. Copies will be sent upon request.

By F. W. Parker, Agronomist,
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Wilmington, Delaware.

The nitrogen fertilization of tobacco has been studied by agriculturists in different states for many years. The experiments have shown that tobacco is a very exacting crop with respect to its nitrogen fertilization because the fertilizer profoundly influences both the yield and quality of the leaf. They have also shown the need for fundamental investigations on the nitrogen nutrition of tobacco that would include studies of the nitrogen requirements of the crop and of the properties of different sources of nitrogen.

During the past 12 years, Doctors P. J. Anderson, M. F. Morgan, O. E. Street, T. R. Swanbeck and their associates have conducted a very thorough investigation of the nitrogen nutrition of tobacco at the Windsor, Connecticut, Tobacco Substation of the Connecticut Agricultural Experiment Station. The data presented in this paper are based on the results which have been published, for the most part, in the Annual Reports of the Tobacco Substation.

Introduction

The cigar tobacco, shade and broadleaf, produced in the Connecticut Valley is heavily fertilized. The usual practice with respect to nitrogen fertilization is to apply 200 pounds of nitrogen per acre. Nearly all of the nitrogen is derived from organic materials such as cottonseed meal and castor pomace. Frequently a small amount of soluble nitrogen is included in the formula. It is obvious that nitrogen fertilization is one of the major problems and an item of considerable expense to the tobacco grower. The Tobacco Substation has, therefore, made extensive experiments on problems relating to the nitrogen nutrition of tobacco.

The Connecticut experiments may for convenience be classified under the following headings:

1. Studies on the optimum soil reaction for the crop and the influence of nitrogen fertilizers on soil reaction.

2. Studies on the nitrogen requirements of tobacco.

Continued on next page

3. Studies in the availability of nitrogen from various materials as influenced by rate of decomposition and loss by leaching.

4. Field experiments comparing sources of nitrogen.

The investigations have included field, laboratory, greenhouse and lysimeter experiments. The influence of treatments on the burning quality, color, composition and physical characteristics of the ash, as well as yield and grade of the tobacco have been determined in most cases. Altogether the investigations, extending over a period of more than ten years are an exceptionally fine and comprehensive study of the nitrogen nutrition of tobacco.

The purpose of this paper is to summarize some of the more important phases of the investigation. First consideration will be given to studies on the optimum soil reaction for tobacco and the influence of different nitrogenous fertilizers on soil reaction. That will be followed by other fundamental studies and finally, the results of a ten year field experiment on sources of nitrogen for tobacco will be summarized.

Optimum Soil Reaction for Tobacco

In 1929, Morgan, Anderson and Dorsey (4) reported the results of an extensive investigation that was made to determine the best soil reaction for the growth of tobacco. The soil reaction in more than 2,000 tobacco fields was determined and the results correlated with the condition of the crop in the field. The data indicated that best growth was secured when the soil had a reaction between pH 5.0 and 5.6. At reactions below pH 5.0, particularly below pH 4.8, acidity was an adverse factor. At reactions above pH 5.6, black root rot was in evidence and injured the crop.

Liming experiments were conducted in the field and greenhouse and confirmed the conclusion reached from the data obtained in the survey. Substantial increases in yield were secured on very acid soils. When the reaction was above pH 4.8, liming did not materially increase yield or grade of tobacco. Cigar tests, (1, page 391) have shown, however, that liming has a beneficial influence on the burning quality and ash characteristics of tobacco. Some of the data obtained in the experiments are given in Table 1.

Continued on next page

Table 1

Cigar Tests on Lime Plots

Character of Fertilizer	Lime Treatment	Number of minutes fire	Color of ash	Coal Band	Coherence	Taste	Aroma
Acid	Lime	7-10	Nearly white	Very narrow, sharp	Flaky	Smooth	Good
	No lime	5-7	Dark gray, muddy,	Wide, not sharp	Good	Bitter	Poor
Alkaline	Lime	6-9	Light gray to white	Narrow, good	Good or a little flaky	Smooth	Good
	No lime	6-7	Medium gray	Medium	Good	Smooth	Good
Neutral	Lime	8-12	Light gray to white	Very narrow	Good	Smooth	Good
	No lime	7-9	Medium gray	Medium to wide	Good	Fair	Only fair

The data show that the use of magnesia lime usually improved the fire holding capacity and color of the ash, resulted in a narrower coal band and improved the taste and aroma of the cigar. Lime caused the greatest improvement with the acid fertilizer and the least improvement when used with the neutral fertilizer. The beneficial results can be attributed largely to (a) change in soil reaction and (b) increased magnesia content of the plant.

Influence of Nitrogen Fertilizers on Soil Reaction

The Connecticut investigators had determined the influence of various nitrogenous fertilizers on soil reaction by 1929. Their data were in close agreement with the quantitative values established by Pierre (6) and that are now in general use by the fertilizer industry. Furthermore, they suggested that the optimum reaction could be regulated to a considerable degree by the proper selection of fertilizers. In their classification, the various organic materials and urea were classified as being slightly acidic; ammonium sulfate, very acidic; and sodium and calcium nitrate were classed as slightly basic in action.

Street (3, page 552) has recently reported the results secured in a study of the reaction of some sources of nitrogen plots on Merrimac sandy loam which were started in 1926. The data reported in table 2 give the average reaction before planting and during the months of June, July and August. All data are the average of weekly determinations made during those months in each of the four years.

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FIG. 1

Nitrogen Content of a Tobacco Crop

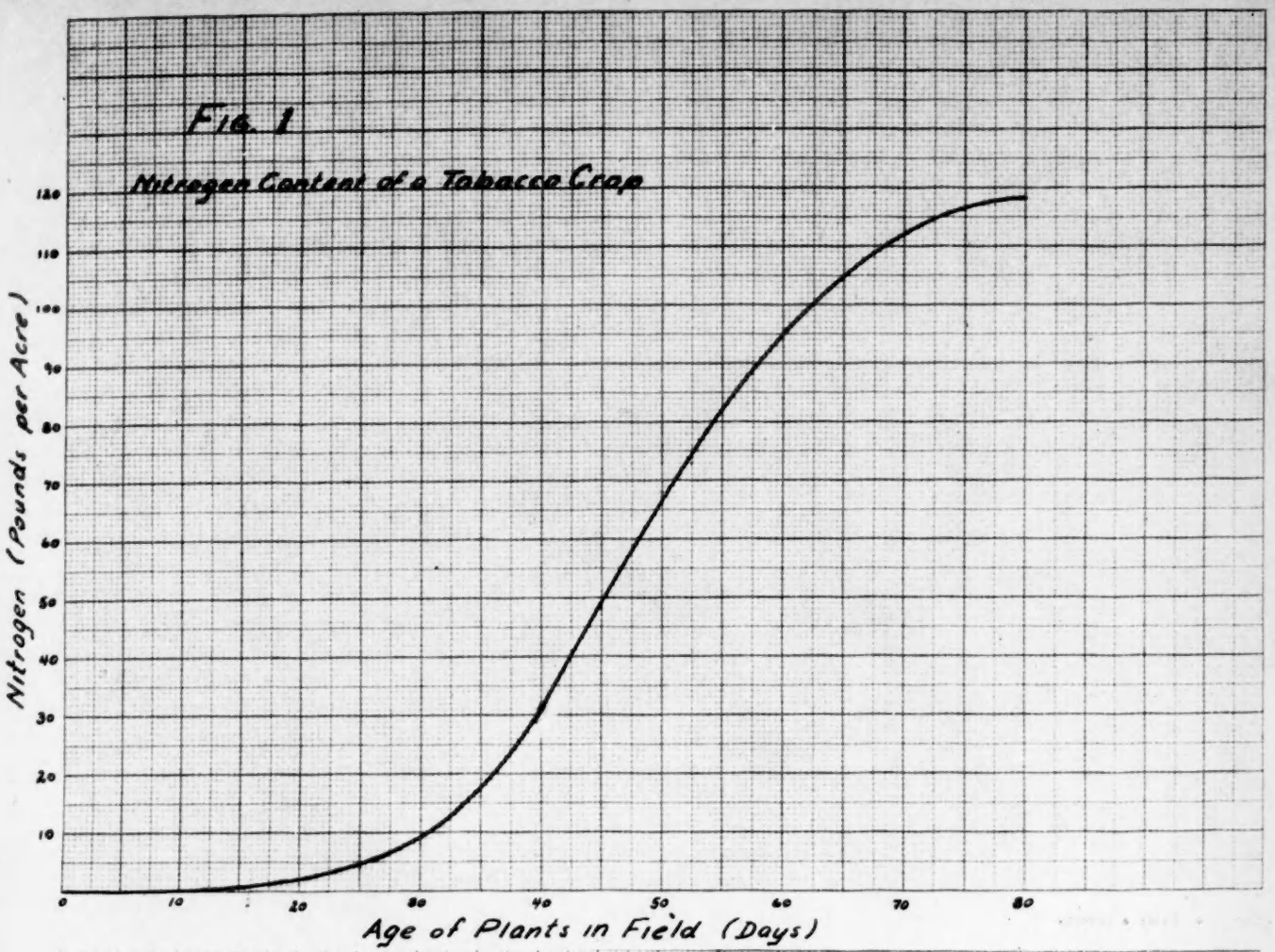

FIG 2

Rate of Nitrogen Absorption by a Tobacco Crop

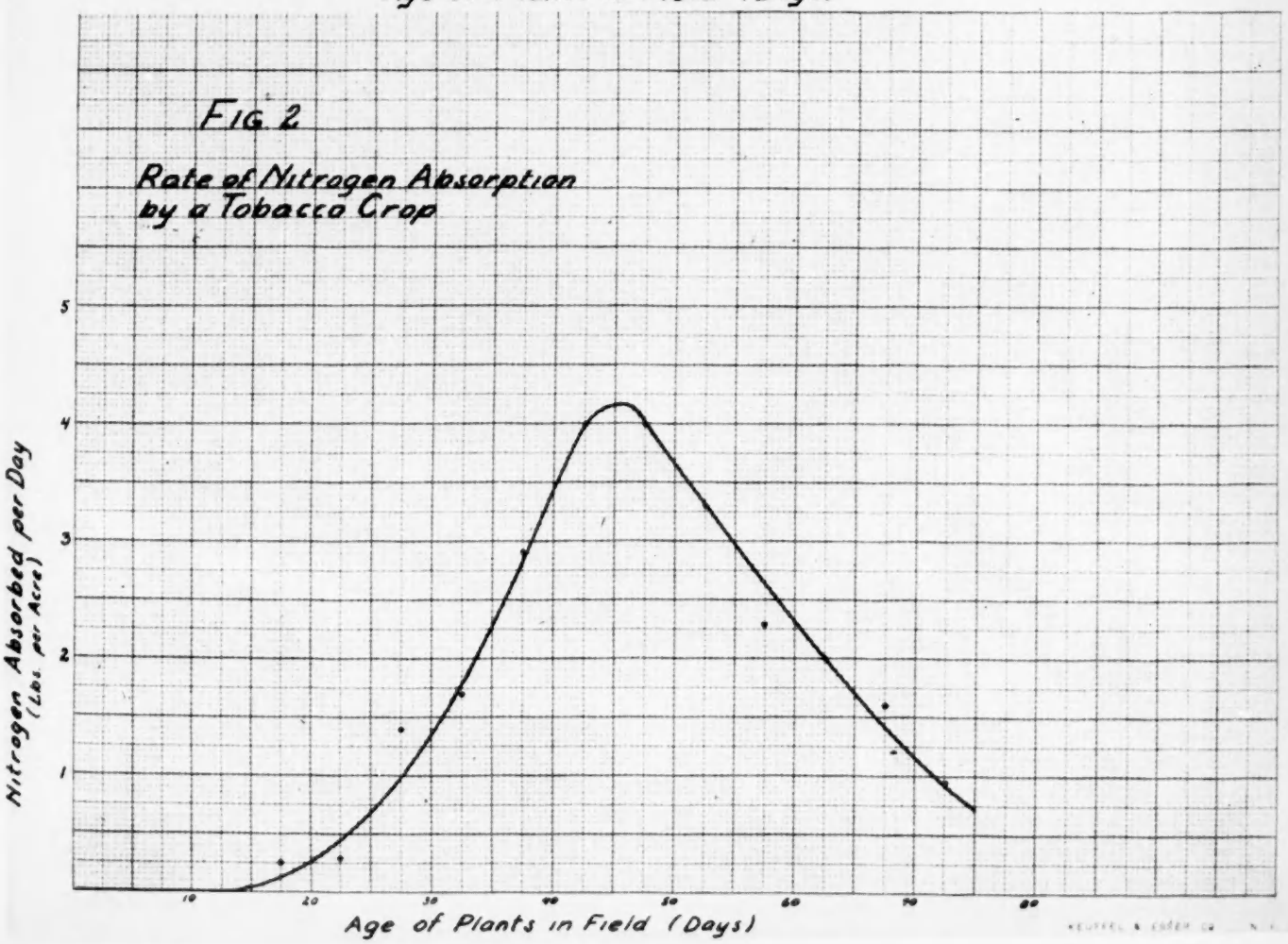

Table 2

Reaction of plots in Single Sources of Nitrogen Experiment Average for the four year period 1932-1935

Period	No Nitrogen	Sodium Nitrate	Ammonium Sulfate	Cottonseed Meal	Urea
April - May	5.42	5.95	4.27	5.22	4.98
June	5.25	5.27	4.08	4.85	4.70
July	5.26	5.34	3.69	4.78	4.20
August	5.23	5.55	3.75	4.82	4.39

These data show that sodium nitrate had slightly reduced soil acidity although the decrease was small during the growing season. As would be expected, ammonium sulfate made the soil extremely acid. Cottonseed meal and urea both increased soil acidity. Urea is slightly more acidic than cottonseed meal, but not nearly so acid as ammonium sulfate. Obviously, such differences in soil reaction will affect the yield and quality of the crop. That relationship will be considered in a subsequent section.

Nitrogen Requirements of Tobacco

Morgan and Street (5) harvested tobacco plants at ten day intervals and determined their weight and nitrogen content. The crops used in this study were fertilized previous to setting with 200 pounds of nitrogen (four-fifths as organic nitrogen, chiefly cottonseed meal; one-fifth as nitrate of soda), 100 pounds of phosphoric acid, and 200 pounds of potash per acre. From the yield and analysis data they calculated the quantity of nitrogen removed from the soil at each stage of growth. The data are shown in figure 1.

These studies indicate that the tobacco crop absorbed less than 2 pounds of nitrogen per acre during the first two weeks it was in the field. In the next three weeks, it absorbed 14 pounds, making a total of 16 pounds per acre for the first five weeks. In the next four weeks, the crop used 84 pounds of nitrogen and during the last ten days before harvest, it absorbed 15 pounds.

The amount of nitrogen absorbed per day is clearly shown in figure 2, where absorption per day is plotted against the age of the plant in the field. The figure shows absorption was negligible until the fifteenth day and then increased rapidly to a maximum of 4.3 pounds per day on the forty-fifth day. Absorption then declined to 2.3 pounds on the sixtieth day and to 1.2 pounds on the seventieth day of the growing period.

The foregoing data on the nitrogen requirement of the crop are of great practical importance. They indicate that there is no need of supplying large quantities of nitrate nitrogen during the first four weeks of growth. The ideal fertilizer material should supply a small quantity when the plant requirements are

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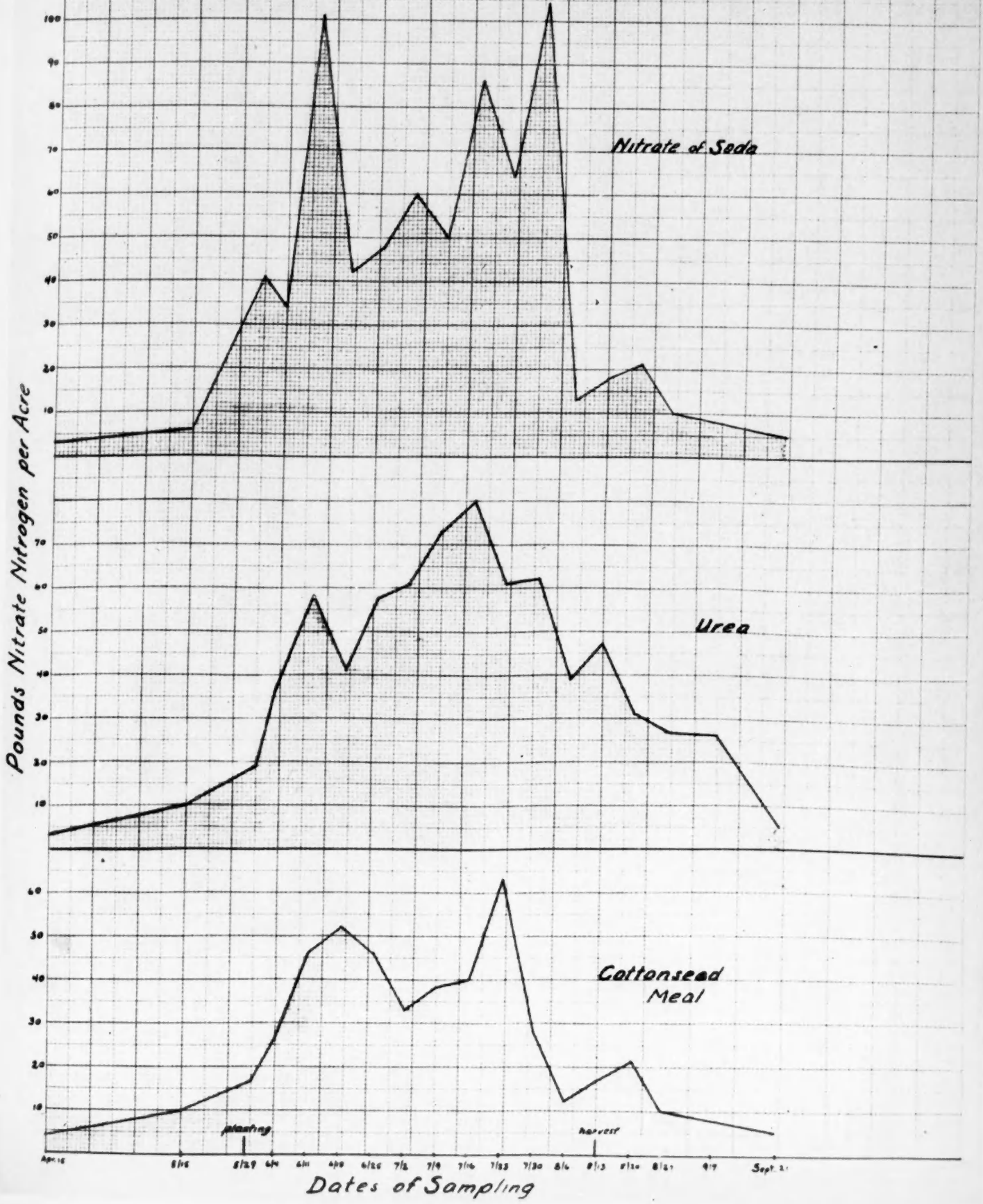
FIG. 3

Average Nitrate Nitrogen Content of Soil on Tobacco Plots



low and a large quantity when requirements are high. By so doing, the nitrogen would be efficiently utilized and losses by leaching minimized.

Nitrogen Supply from Various Nitrogenous Fertilizers

Having determined the nitrogen requirements of the tobacco crop, Street undertook a study to determine the degree to which various nitrogen materials met the demands of the crop. It is well known that tobacco absorbs most of its nitrogen as nitrate nitrogen. Street (3, page 552), therefore, determined the amount of nitrate nitrogen in the soil at weekly intervals during the growing season. The study was continued for four years and only the average results will be considered here.

The plots used for the study had received the same fertilizer treatment since 1926. In that year, four plots on Merrimac sandy loam were started in a source of nitrogen experiment in which the four major forms of nitrogen were compared. The forms of nitrogen and materials used were as follows*:-

Nitrate nitrogen	- sodium nitrate
Ammonia nitrogen	- ammonium sulfate
Insoluble organic nitrogen	- cottonseed meal
Soluble organic nitrogen	- urea

Each material, together with phosphate and potash was applied before planting at a rate to give 200 pounds of nitrogen per acre. Leaching of the nitrate of soda was so great that the crop was practically a failure during four of the first five years of the experiment. Consequently, during the period of the nitrogen supply study, 1932 to 1935, nitrate of soda was applied in five fractional applications made at approximately 10 day intervals after planting. The continued use of ammonium sulfate without lime made the soil so acid that in the last four years, the yield was small and of low grade. Furthermore, the extremely acid condition doubtless influenced nitrification. This discussion of the nitrogen supply data will, therefore, be limited to the results secured with nitrate of soda (five applications), cottonseed meal and urea. The data secured are given in table 3 and figure 3.

*During recent years the experiments have included several other forms of insoluble organic nitrogen and calnitro. The references should be studied for the results secured with these sources of nitrogen.

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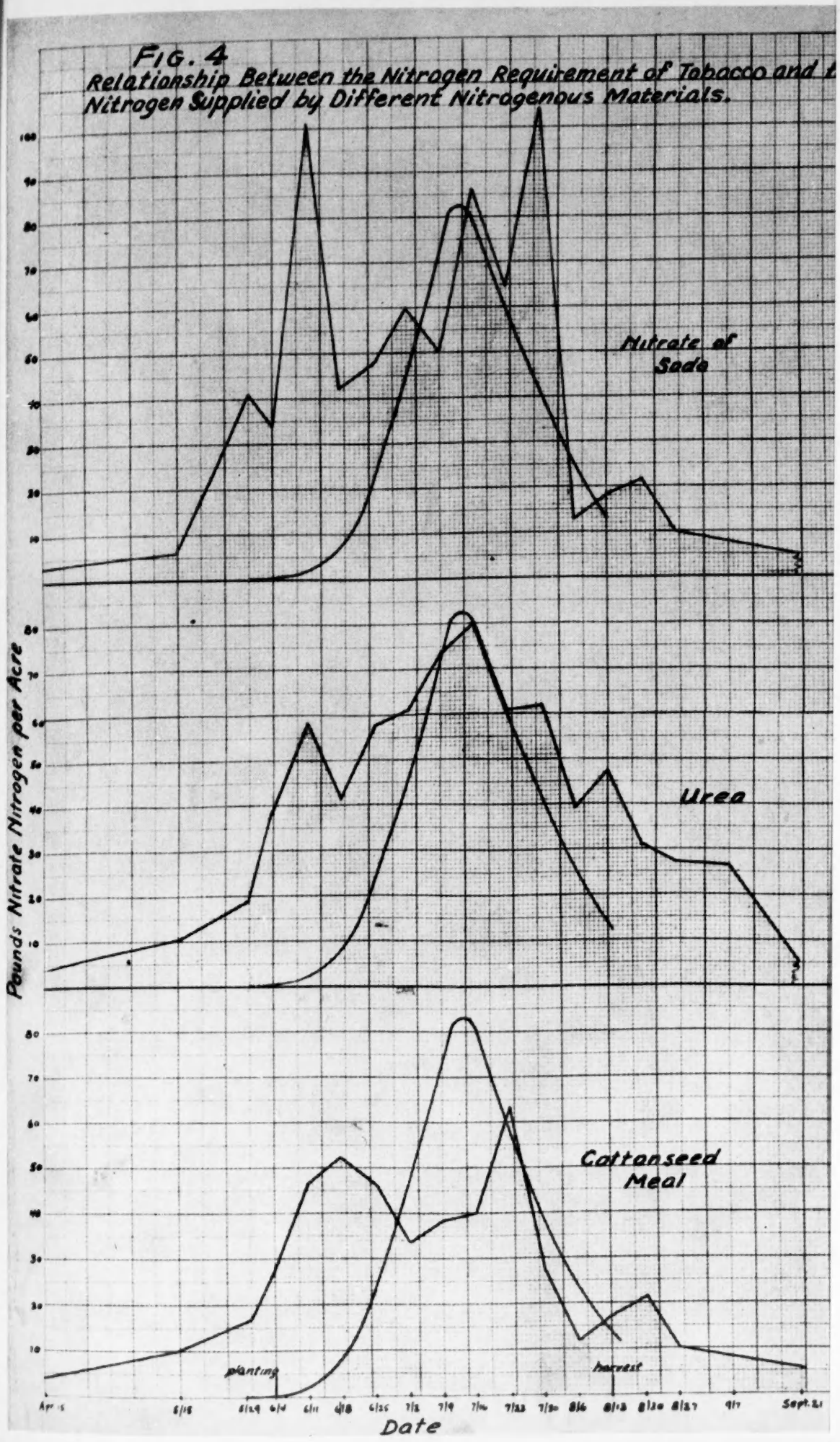
FIG. 4

Relationship Between the Nitrogen Requirement of Tobacco and t
Nitrogen Supplied by Different Nitrogenous Materials.



per Acre
1: Urea
:
; 10
:
: 39
: 60
: 77
: 62
: 39
: 39
:

FIG. 4

Relationship Between the Nitrogen Requirement of Tobacco and the Nitrate Nitrogen Supplied by Different Nitrogenous Materials.

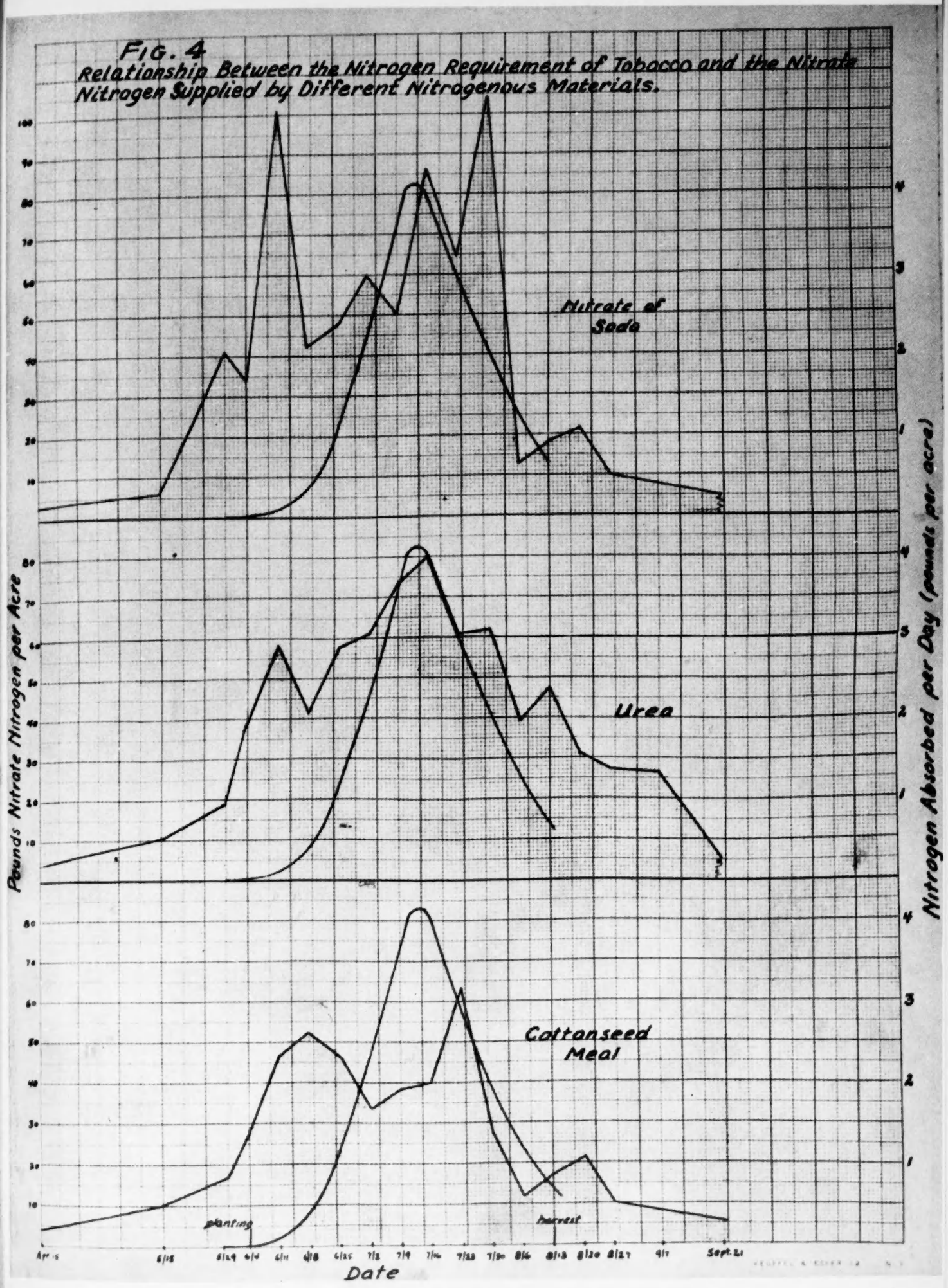


Table 3

Effect of Various Nitrogen Fertilizers on the Nitrate Nitrogen Content of the Soil
(four year average)

Period of Growth	Plant Requirement for N	Dates Averaged	Nitrate Nitrogen in Pounds N per Acre		
			Sodium Nitrate	Cottonseed Meal	Urea
Before planting	--	May 15	6	10	10
0 to 21 days	Very low	May29,June 4,11,18	55	37	39
22 to 35 days	Low	June 25 - July 2	54	40	60
36 to 49 days	High	July 9 - 16	68	39	77
49 to 63 days	Medium	July 23 - 30	83	46	62
63 to 72 days	Low	August 6	13	12	39
2 wks. after harvest	--	August 13 - 20	20	16	39

The data of table 3 were prepared by averaging the data reported by Street. The averages indicate the average nitrate nitrogen content during different periods of the growth of the plant. The original data are plotted in figure 3.

The data of figure 3 show that even with five fractional applications of nitrate of soda, the nitrate content of the soil reached a very high level, 101 pounds of nitrogen per acre, during a time when the nitrogen requirements of the plants were quite low. This condition would have been much worse if all the nitrogen had been applied at planting as was the case with the other two materials. Five applications of nitrate of soda maintained a high level of nitrate nitrogen in the soil during the period of high plant requirement and then reached a low level at the time of harvesting.

The urea and cottonseed meal plots started off at about the same level of nitrate nitrogen. After the 21st day, urea produced a considerably higher level of nitrate nitrogen than cottonseed meal. The difference was most marked during the period of high plant requirement. At that time, the nitrate content of the soil on the urea plot was double that on the cottonseed meal plot. During the 36-63 day period, urea maintained about the same level of nitrate nitrogen as was secured by fractional applications of nitrate of soda. The urea plot differed, however, from the other two plots in having a high nitrate content at and following harvest. These differences are very clearly shown by a study of figure 3. Note that urea has given a smoother line than either nitrate of soda or cottonseed meal. The former is subject to great fluctuations and the latter appears to recover slowly from a low level that may be caused by leaching or plant absorption of the nitrate nitrogen.

The higher nitrate level on the urea and nitrate of soda plots as compared to the cottonseed meal plot, table 3, is doubtless due in large measure to the

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lower total availability of nitrogen in the natural organic. Morgan and Street (1,5) have found by lysimeter experiments in which the crop and leachings were analyzed that only about 60 per cent of the nitrogen in cottonseed meal becomes available during the growing season. On the other hand, practically all of the nitrogen in urea and inorganic sources of nitrogen are available to the crop in the growing season. On the basis of these findings, the suggestion has been made that 150 pounds of nitrogen in urea would be as effective as 200 pounds of nitrogen in natural organics such as cottonseed meal.

Field Experiments with Single Sources of Nitrogen

As previously indicated, a field experiment on sources of nitrogen for tobacco was started on Merrimac sandy loam in 1926 and has been continued ten years. The 1929 crop was destroyed by hail so yields were secured for only nine years. Data on the reaction and nitrate levels in the plots of this experiment have been given, pages 24 and 26. The yields and grade index for successive three year periods are given in table 4.

Table 4

The Yield and Grade Index of Tobacco Produced with Different Sources of Nitrogen

Period	Sodium Nitrate*	Ammonium Sulfate	Cottonseed Meal	Urea
	Yield, pounds per acre			
1926 - 1928	904	1267	1018	1131
1930 - 1932	1071	1615	1587	1668
1933 - 1935	1760	1060	1484	1912
Av. 1926 - 1935	1245	1311	1363	1570
	Grade Index**			
1926 - 1928	.214	.353	.295	.389
1930 - 1932	.233	.351	.393	.413
1933 - 1935	.417	.153	.351	.370
Av. 1926 - 1935	.288	.286	.346	.391

*Prior to 1932, all sodium nitrate was applied before planting as were the other materials. Beginning in 1932, sodium nitrate has been applied in five fractional applications.

**The larger the figure, the better the grade.

Sodium nitrate produced poor yields of tobacco having a low grade index during the first two periods. Good crops of good grade were produced in 1926, a relatively dry year and since 1932 when fractional applications were started. In

Continued on next page

the other four years, heavy loss by leaching resulted in very poor crops. It is interesting to note, however, that during the last three year period, fractional applications, sodium nitrate produced good yields of high grade tobacco.

Ammonium sulfate produced good yields of fair to good grade tobacco during the first six years of the experiment. During that time the soil had become so acid that yields for the last period were low and the crop was of poor quality. Anderson et al (3, page 349) have shown in another experiment that the use of lime with ammonium sulfate materially improves both the yield and grade of the crop.

Cottonseed meal produced fairly good yields during the entire experiment. The yields, however, were not so good as those secured with urea or with ammonium sulfate during the first two periods. The tobacco from the cottonseed meal plot was of good but not exceptionally good grade. Ammonium sulfate produced a higher grade during the first period and sodium nitrate produced a higher grade during the last period. Throughout the entire experiment, urea produced a better grade tobacco than did cottonseed meal.

Urea has produced a better yield than any of the other sources of nitrogen. Ammonium sulfate produced a higher yield during the first three years but urea ranked first in yield in all other periods, including the average for the nine years. Urea has also produced the highest grade tobacco with the exception of the last three year period, when nitrate of soda, fractional applications, produced the highest grade tobacco.

Yield and Grade in Relation to Acidity: This is most strikingly shown by the results secured with ammonium sulfate and already given in table 4. During the first three year period, 1926 - 1928, ammonium sulfate produced the highest yield and the crop had a high grade index. At that time, the soil was not very acid and acidity was not causing poor results. By 1933, the soil was very acid and consequently the yield in 1933-1935 was very low and the crop was of very poor quality, grade index of .153.

It has already been shown, pages 22 and 23, that tobacco grows best at the reaction of pH 5.0 to 5.6, and that liming soils below pH 4.8 usually increases yields and nearly always improves the quailty of the crop. It seems very probable, therefore, that larger crops of better grade tobacco would be produced by cottonseed meal and urea, especially the latter, since it is the more acid, if those plots were limed to pH 5.0 to 5.5. Table 3 shows that during July, the period of maximum crop growth, the urea plot had a reaction of pH 4.20. Under those conditions, an application of lime should be quite beneficial.

Yield and Grade in Relation to Leaching: This relationship is clearly shown by a study of the results secured on the sodium nitrate plot. As previously indicated, all the nitrate was applied before planting in the years 1926-1931 inclusive. During this time there was only one year, 1926, when rainfall in June or early July was so low that leaching was not serious. Table 5 gives the yield and grade of tobacco produced on the sodium nitrate plot in the dry year of 1926, in the years 1927 - 1931, and when fractionally applied to reduce leaching in 1932 - 1935.

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Table 5

Yield and Grade Index of Tobacco Produced with Sodium Nitrate

Period	Description of Conditions	Yield, lbs per Acre	Grade Index
1926	Nitrate applied at planting, dry year	1440	.353
1927 - 1931	Nitrate applied at planting, normal years	701	.144
1932 - 1935	Nitrate applied in 5 applications	1741	.416

The data show that normally leaching is an important factor influencing both yield and grade of the crop if a source of nitrogen which is readily leached is used in fertilization. When leaching was minimized as in 1926, or by the fractional applications, good yields of high grade tobacco were produced with nitrate of soda. A study of table 4, comparing the results secured with urea, cottonseed meal and ammonium sulfate with those secured with sodium nitrate clearly shows that the nitrate is the only source of nitrogen subject to serious loss by leaching. This finding has been confirmed by lysimeter studies reported by Morgan et al (1).

Yield and Quality in Relation to Nitrogen Supply: In discussing his data, Street (3, page 567) makes the following statement:

> "The question of supply and demand in the nutrition of tobacco plant is the ultimate measurement of the value of any material."

Figure 2, calculated from the data of Morgan and Street, shows very clearly the requirements of the tobacco crop. It shows when and how much nitrogen is needed during the growing season. The best nitrogen fertilization should meet these requirements and not provide an excess of nitrate nitrogen when the plant requirement is low as at the first and last periods of growth.

The data of figures 2 and 3 are shown together in figure 4. This figure then shows how the various nitrogenous materials furnish nitrogen in relation to the nitrogen requirements of the tobacco crop. It should be noted that the nitrogen requirement of the crop is expressed in pounds of nitrogen required per day, whereas the nitrate supply from various materials is given in pounds of nitrate nitrogen per acre at different dates on a cropped area. The amounts shown are, therefore, in excess of the quantity absorbed by the crop at the date indicated.

A study of figure 4 shows that even with fractional applications, nitrate of soda furnished large quantities of nitrate nitrogen at times when the plant's requirements were low. The nitrate supply, however, was well maintained and excellent crops of tobacco were produced. This inorganic, easily leached source of nitrogen when properly handled to meet the plant's requirements, produced a larger crop of better grade than did cottonseed meal.

Cottonseed meal met the crop requirements rather satisfactorily. The nitrate

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level, however, was relatively low at the time the plant requirements were greatest. The nitrate level was satisfactorily low in June when the plant requirements were low and the same condition obtained during the last week of the growing season.

Urea produced nitrates more in accord with the plant's requirements than any of the other sources of nitrogen. The nitrate level on the urea plot was satisfactorily low in June when the plant requirement was low. As the plant requirement increased, the nitrate level increased, after which it declined. The nitrate level with urea was relatively high at harvest, possibly too high for the best grade or quality of tobacco. That condition doubtless could be corrected by reducing the amount applied. This has been indicated by Street in discussing his data:

> "Among the inorganics only urea is worthy of note. The nitrate production of this material was greater than any of the organics, yet in the same order, and at a rate to produce a curve of the same type. Furthermore, the ready decomposition of urea, as indicated by its rapid recovery after rains, perhaps justifies the use of less total nitrogen in the formula where this material is employed. The low post-harvest level of urea would indicate that the greater part of this material becomes available during the growing season."

Discussion

This situation regarding the merits of different sources of nitrogen for tobacco is well summarized by Anderson et al (3, page 546):

> "A great many materials are available to furnish the necessary nitrogen in the tobacco fertilizer mixture and new ones appear on the market every year. It is a common belief among tobacco growers that certain ones have specific effects on the crop. For example, some hold that castor pomace makes the crop darker; linseed meal gives it a higher 'finish'; fish meal makes a red leaf, etc. For the most part, such ideas are based on personal observations or hearsay, or on claims of salesmen, and not on accurate experimental evidence. Also larger yields are claimed by the champions of each material.
>
> "The scientific agronomist, on the contrary, believes little in specific effects. He points out that these materials are first decomposed in the soil and absorbed by the plant as nitrates, or, to a less extent, as ammoniates. The nitrate is the same whether it originates from cottonseed meal, dry ground fish, nitrate of soda, or other sources. Why then, should the individual materials produce different results on the plants? One can only surmise that if such specific effects do occur, they must be due to different rates at which the materials decompose and become available, or to subsidiary elements that enter the roots with the nitrogen.

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"As early as 1892, the Connecticut Agricultural Experiment Station began field experiments with the object of comparing the effects of different nitrogenous materials on the yield and grading of tobacco. Since that time, there have been numerous similar experiments in this and other states with various old and new nitrogenous materials, but still there is no agreement as to the comparative merits of even the common ones."

The failure to secure agreement as to the relative merits of the different materials is due in large measure to failure to understand the essential factors involved in the nitrogen nutrition of the plant. The Connecticut investigators have clearly shown that those factors are:

1. The nitrogen requirements of the crop, time and amount needed.

2. The supply of nitrate nitrogen furnished by the various materials. This, of course, means the supply available to the plant.

The Connecticut investigators have also clearly shown that the important factors influencing the relative value of most sources of nitrogen for tobacco are:

1. Time, rate and amount of decomposition, namely, ability to meet the plant requirements for nitrate nitrogen.

2. Influence on soil reaction.

3. Resistance to loss by leaching.

If these factors are properly appreciated and the various nitrogen materials used in accordance with their peculiar properties, most of them will produce very satisfactory crops of tobacco. The choice of a nitrogen fertilizer will then depend in large measure on its cost per unit of nitrogen and ease with which it can be safely and efficiently used on the crop.

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TREATMENT VERSUS MISTREATMENT OF SEEDS IS NOT WELL UNDERSTOOD BY MANY FARMERS

EDITOR'S NOTE:- This article is for publication in media reaching farmers. It appears here in advance of its use elsewhere. County agricultural agents and others in contact with growers may make any use of the article they desire, with or without credit.

By Gilbert F. Miles,
Research Department,
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Every day in the year is planting time in the United States. From the first to the last day of the year farmers in some section of our country are planting their crops. While the New York dairyman is shoveling his way to the barns through mountainous drifts of snow, the Florida potato grower is cutting and planting his seed potatoes. And before the North Dakota wheat grower has pulled his grain drill out of the shed in preparation for sowing his wheat crop, the Texas cotton grower is busily engaged in plowing the long rows of cotton. Thus it is that seed problems are being pondered and considered by farmers somewhere in this country from one year's end to the next.

All engaged in agriculture and in many other industries in this country are seed-conscious. Is good seed corn scarce in the Corn Belt? The answer is of interest to many more than those growers who produce our corn crop. The feeder of cattle and hogs, the growers of other grains whose prices rise and fall in sympathy with changes in corn prices, the manufacturer who uses products made from corn, the millers and processors who must protect themselves against future prices -- all these are interested in the condition and supplies of seed available.

Farmers themselves are far more alive to the importance of the role played by seeds than they were even a few years ago. They are realizing more than ever that quality and breeding in seeds are of vital importance to the success of the resulting crop. Hence, seeds are beginning to obtain the attention their importance to successful crop growing has always justified, but which man in his blundering way has frequently neglected to provide. One has only to consider the tremendous amount of time and labor devoted to the problems of breeding seeds in an effort to produce higher yielding or better quality crops, to realize that seed is rapidly coming into its own.

Interest in Seed Treatment

One easily discernible proof that growers everywhere are becoming more seed-conscious is the greatly increased interest in the advantages of seed disinfection

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as a means of controlling many plant diseases. The more aggressive growers have been quick to follow closely the results of experiments and demonstrations by the U. S. Department of Agriculture and their state colleges. More conservative farmers, watching over the fence, have observed the beneficial effects of treating seed potatoes, corn, cotton, grain, and many other crop seeds, and they too are adopting seed treatment as a regular farm practice.

In many cases seed disinfection is leading the way to other improved practices in handling seed. A grower convinced of the importance of seed treatment is much more apt to accept at face value the importance of seed selection and breeding, germination tests, proper storage, cleaning, and correct planting methods.

Remarkable as is the progress being made in crop improvement through the control of many seed-borne diseases by seed disinfection, there is yet much room for improvement. There are still too frequently failures and disappointments and, as a result, skepticism concerning the efficacy and advantages of seed treatment. These difficulties are due usually either to failure to comprehend the principles underlying the practice of seed treatment, or to negligence or carelessness in following recommended methods.

Examples of seed "Mistreatment"

Witness, for example, this farmer driving up to the elevator for a load of seed wheat. Beside him on the seat of the truck is a package of seed disinfectant. A glance at the label tells us the product is one used by wheat growers for nearly twenty years to control stinking smut of wheat. It is a good seed treatment for this purpose, and you wonder idly why he should be returning it to the elevator. Wait until the truck has been filled with seed wheat and you will see why seed treatment sometimes fails. With his truck loaded, the farmer opens the container of seed treating compound and scatters the contents over the surface of the load. Possibly he senses your surprise and inquisitiveness, for he remarks with a note of pride in his voice, "Never saw seed treated this way before, did you?" Without waiting for you to reply, he explains that the jolting of the homeward trip will cause the dust to sift downward through the load and thus treat the seed without any extra work on his part. So far, so good; but the rest of the story isn't so pleasant. At harvest time an actual count in the field sown with this seed shows 17% stinking smut. That represents at once a 17% loss in yield plus an additional loss of several cents per bushel for smut dockage.

Does that sound to you like an exaggerated yarn? It isn't, for it actually happened in one of our great wheat growing districts. And worst of all, similar mistakes are made in treating seed on thousands of farms every year.

Here's another true story of a farmer who erred in a somewhat different manner. A visit to his farm a few days before planting time, found him busily engaged in treating his seed wheat by means of a recently purchased, power driven, modern seed treater. The dust disinfectant being used had been recommended by his druggist and the farmer was using it for the first time. A peek at the treated seed in the sacks showed instantly that far more than the recommended dosage of dust was being applied. The rate of application recommended was

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one-half ounce of the dust per bushel of seed. A quick count of the number of sacks treated and of the amount of dust used showed that the grower was applying nearly three ounces of dust per bushel of seed instead of the recommended one-half ounce, or almost six times the recommended amount! On the 150 bushels of seed already treated he had used more than enough to treat the entire 800 bushels he expected to plant. Fortunately the treatment had an ample margin of safety, and so far as could be told from watching the crop during the season, no harm resulted to the seed. But for our timely visit, however, he would have spent nearly $100 for seed treatment instead of $15. The most astonishing feature of this incident is that the farmer confessed he had never heard of the product until his druggist advised its use, and yet he had begun treating his seed without even reading the directions on the label!

Costly Mistakes are Common

Many of the mistakes made in treating seeds are not as flagrant as those described, but still are far more costly. For example, the potato grower who dipped his seed potatoes in a seed treating solution, which had been carefully prepared, followed directions to the letter until he piled the cut and dripping seed to a depth of four or five feet in a large bin. No amount of argument at the time could convince him that the seed would heat and deteriorate greatly during the two or three days it was to remain there before planting. The fifty per cent stand, which this seed produced, did convince him, however, and now he is more careful about storing cut seed potatoes, treated or untreated, in deep piles.

None of these cases is fictitious; they are all true stories of mistakes made in treating seeds. They have been selected because they illustrate cases of "seed mistreatment" as contrasted with "seed treatment".

The corn grower who treats his seed corn thinking thereby to control corn smut, the barley grower who fails to realize the difference between loose smut and covered smut, and the potato grower who expects seed treatment to control scab on his scab-infested soil may all find some excuse in the technical nature of their errors. But what of the oats grower who applies a pint of disinfecting solution to fifty bushels of seed oats when the recommendations distinctly call for a quart of the solution to that amount of seed? The ten per cent loss by smut in his oats crop could have been prevented so easily by a little more care in following simple instructions. A loss like this of a few bushels in yield per acre may not seem large until it is multiplied by the number of acres of oats on the farm; then it may easily amount to enough to pay the tax bill, buy a new binder, or put a new roof on the house.

Intelligent Understanding Necessary

The practice of controlling plant diseases by seed treatment has many possibilities for profit, but to make the most of it, an intelligent understanding of the purpose of seed disinfection and the use of common sense in applying this knowledge are essential to success. During the winter months there is usually ample time to canvass the situation on the individual farm, and to learn which crops can be benefited by seed treatment. Information on the subject can be

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secured from county agents or a post card addressed to your State College or to the U. S. Dept. of Agriculture at Washington will bring you circulars or bulletins on the subject. Simply request literature regarding the disinfection of seeds planted on your farm. An hour or so some evening spent in reading bulletins of this sort will inform you of the possibilities of seed treatment on your farm, will tell you what products have been tested and recommended, and how to use them.

Instructions regarding the use of homemade and commercial seed treating equipment can be secured from the same sources or by writing to the manufacturers of seed treating chemicals. On the average farm elaborate or expensive equipment is not needed. Seed treaters are easily constructed from drums, tubs or other simple and inexpensive material easily obtained. Once made, such a treater should last for years.

Having selected the seed disinfectant or disinfectants which you plan to use, procure your supply before the last minute demand for such products has exhausted your dealer's supply. Take time to read the directions, not once, but two or three times. Make certain you understand for which seeds the product is recommended, what diseases can be wholly or partially controlled by its use, and at what rate and in what manner it should be applied.

Handling Seed After Treatment

After applying the disinfectant at the proper rate and in the correct manner, follow the recommended procedure in the further handling of the seed. In some cases seed treated with liquid disinfectants must be covered for a period of five or six hours and then stirred several times to eliminate the toxic vapors. In other cases seed must be held in piles without covering or in sacks for 24 hours before planting. Where soak or dip treatments are used, it is usually necessary to dry the seed thoroughly to prevent heating during storage. These instructions are important; failure to follow them may result in poor disease control results and even in serious injury to the seed.

With one or two possible exceptions, the recommendations for disinfecting seed are simple and easily carried out. A little time devoted by the farmer to familiarizing himself with the proper methods and a little care in applying them are all that is required. Correctly used, seed treatments in general can usually add more to the farm income than can be secured by any other similar expenditure of time and money. It usually pays to "treat" seeds; it never pays to "mistreat" them.

AMERICAN WILDLIFE INSTITUTE REPORTS PROGRESS IN ORGANIZING RESEARCH AND OTHER ACTIVITIES

EDITOR'S NOTE:- The restoration of wildlife is recognized as a matter of vital interest to agriculture from various angles. Therefore, space is given to a discussion of present activities which give promise of bettering a situation that was little short of alarming to those familiar with the existing conditions.

By Henry P. Davis, Secretary,
American Wildlife Institute,
Investment Building,
Washington, D. C.

Pointed toward the acquisition of much needed basic knowledge of wildlife, its habits and its needs, and the mobilization of conservation forces to utilize and apply that knowledge are the two outstanding elements of the progressive program of the American Wildlife Institute, now well under way. That definite progress has been made toward the accomplishment of both aims is a most encouraging fact.

The Institute was organized by business executives who realize that the perpetuation of the sports of hunting and fishing and the maintenance of an ample supply of wildlife is essential to the welfare of this country. They have grown weary of seeing worthy conservation movements go by default for lack of the support of those most vitally concerned. They believe that the application of sound business principles to game and fish restoration activities will bring success in the same degree as has marked the progress of American industry, and they believe that a program predicated on that basis will have the support of the industries which are commercially concerned in an annual crop of wildlife. So the Institute was organized, not to attempt the actual mechanics of wildlife restoration but to do an organization job.

Therefore, two primary jobs were undertaken. First, a series of cooperative research and demonstration projects were organized in nine widely scattered states. Second, the General Wildlife Federation was organized in a temporary form at the North American Wildlife Conference in February 1936. A third activity was to be the dramatization of the present plight of wildlife and the importance of this natural resource in the scheme of every day American life, not only as a matter of recreation but as a vital biological item.

The research and demonstration program was immediately launched. The North American Wildlife Conference was called last February by President Roosevelt at the instigation of the Institute and the mobilization of conservation forces initiated here. The General Wildlife Federation was set up in temporary form with J. N. ("Ding") Darling as its president.

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These two are of sufficient importance to merit elaboration. There is much of interest to be told of the first year's work.

Research Program Developed

To begin at the beginning -- through the generosity of the Remington Arms Company, E. I. du Pont de Nemours & Company, and Hercules Powder Company, the American Wildlife Institute was able to approach the Biological Survey with a suggested plan of cooperative financing of wildlife research and demonstration. A one hundred fifty thousand dollar fund was made available for this purpose over a period of five years by these three companies.

A three-way cooperative plan was developed involving four prominent agencies. The American Wildlife Institute and the U. S. Bureau of Biological Survey constitute the first and the state game commissions and land grant colleges the other two. Each financed one third of the expenses of the projects. Such a plan was submitted to the state game commissions and land grant colleges of each state and 39 of the 48 immediately expressed not only a desire but eagerness for one of these units. Available funds would permit of developing but nine.

So, under supervision of the Biological Survey projects were developed in Maine, Connecticut, Ohio, Virginia, Alabama, Texas, Iowa, Utah, and Oregon. These were so scattered in order to place the centres of research in ecological or natural environmental regions. The land grant college became the locale.

Competent biologists, selected by the Survey for their executive and administrative ability as well as their scientific standing, were assigned to each unit as leader. Nine work programs were devised and competent personnel developed.

At the present time a young army of over 142 research workers is engaged in these 9 projects. Aside from the nine project leaders there are nine full-time research men, 33 graduate students, 37 temporary assistants including undergraduate students, 45 college staff members engaged in specific studies, and nine clerical assistants. Approximately $195,000 is being spent on these projects annually.

Investigations Under Way

The private lives of 17 species are being investigated. Full life history studies are being made of the mourning dove in Alabama, the cottontail rabbit in Connecticut, striped and spotted skunks, coot, cottontail, and bluewing teal in Iowa, gray and fox squirrels in Ohio, antelope in Oregon, Attwater prairie chicken in Texas, mule deer, sage grouse and sharptail grouse in Utah, woodcock in Maine and wild turkey in Virginia.

Numerous other studies of varying character are under way. Many of these were requested by the cooperating game commissions. These deal in large part with practical problems of immediate concern to the commission. Some have already proved their worth. In Utah, for example, Commissioner Cooke has stated that the information derived from one study has already justified the use of state funds for this purpose. This particular study dealt with a condition on

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certain lakes where a fluctuation of water level was having a harmful effect on fish.

In Connecticut a statistical study of the annual reports of hunters is being made to determine how best to use these reports.

The introduction of Mexican quail has always been a bone of contention. At the Texas project a study of the effect on our native bobwhites of the introduction of Mexican quail is under way to determine once and for all just what this may be.

Raising really wild wild turkeys has been an insurmountable problem of the game breeder. Many claims of success have been made but little actual success demonstrated. At the research unit in the mountains of southwest Virginia, Charles Handley has undertaken this as one of his major problems. Only one year has passed and while no definite information is available until yet another year has proved the results of this year, hints of unbelievable progress have been evidenced.

These are only examples of the jobs undertaken at these units. These projects are not simply set up for the acquisition of an enlarged fund of highly technical knowledge understandable to a few bewhiskered scientists. They are designed to get dope to put to work on the lands of every interested farmer in the country for the purpose of increasing his annual crop of game and other wildlife.

Farmers Interested

Farmers short courses every summer are held at each of these colleges and by an exceptionally keen, intelligent lot of farmers who are desirous of keeping themselves abreast of progress in farm practise. These men evidenced great interest in what they have seen and what they have been told at these research and demonstration projects.

In Texas, Dr. Walter P. Taylor, project leader, contacted over 4000 farmers this summer, and received a most encouraging reaction.

The future farmers of the country are playing a definite part in this program. At each of these stations, the 4-H Clubs are being brought into contact with the good work. During the past summer over 400 boys came under the influence of the Oregon project for training. Next year these boys will be leaders in the work for the new comers. In the meantime a winter contest is being planned to maintain their interest and keep wildlife a prominent part of their activities.

About three years ago Iowa created for the first time in history the position of extension agent for wildlife conservation. This year as a direct result of the work of these research projects Texas has created a similar position and assigned thereto Mr. R. E. Callender, an experienced county agent with a particular interest and understanding of wildlife and its problems.

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Extension Service Cooperating

Still more important, the U. S. Extension Service has recently drafted Mr. I. T. Bode, who has been in general supervision of this research and demonstration program for the Biological Survey, to be Extension Specialist in Biology and Wildlife Management. In his new position Mr. Bode will have an exceptional opportunity to tell the story of wildlife to those best able to do something about it, the farmers and landowners.

These projects run the gamut of biological investigations. They include everything from protozoa to moose, from planting small food patches for game to the study of the management of immense tracts of forest land for wildlife and the effect of cutting timber on them.

Too much cannot be expected in a brief time. Research is not an overnight job. It is a question of continued study over a period of years. For this reason these projects were set up for a period of five years.

Chief Gabrielson of the Biological Survey states that "This work should be expanded. There are six additional major and two smaller regions in this country that need to have a similar service if we are to have some needed information on wildlife management that can be applicable to any part of the country. We now have nine stations, but there certainly need be fifteen stations and two substations doing research and applying the results on an experimental basis."

This research is only a start on what is proposed. The Institute's Technical Committee has drafted a national research program of considerable proportions and great scope. As the necessary finances are acquired this program will be put into operation. This committee is composed of a group of scientists nationally known for their work in wildlife research and also for the practical work they have done.

Wildlife Federation Organized

To acquire scientific information is one thing, but to apply it on a scale of sufficient magnitude to be of material value to the country as a whole is entirely beyond the potentialities of any one organization or group. For this reason and for the reason that past experience has indicated that new ideas and methods are essential to accomplish this aim, events leading up to the formation of the General Wildlife Federation were planned and executed.

Some people are confused concerning the relationship between the American Wildlife Institute and the General Wildlife Federation. The Institute is very definitely interested in the organization of the Federation because it believes that such an unification of interests and effort is a basic essential. For this reason the Institute initiated the steps leading to the Federation at the North American Wildlife Conference last February, financed the preliminary organization work and plans to continue to act as a financial backlog during the formative period of the Federation.

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Under the able direction of the U. S. Junior Chamber of Commerce, the preliminary organization was formed. The American Wildlife Institute provided $6,000 for this work. The Institute employed a temporary secretary to handle the affairs of the Federation for several months and then continued to do so with its own personnel.

Thirty-eight of the forty-eight states of the Union now have their conservation forces federated under a state organization. Nine of these are not yet actively functioning but the preliminary work has been accomplished and time will take care of the rest. This is decidedly encouraging. It is hoped and expected that a large delegation will attend the 2nd North American Wildlife Conference, which the Institute will sponsor, in St. Louis, Mo., on March 1, 2, 3, and 4, next. At this meeting the Federation will be set up in permanent form and permanent officers elected. The potential force of this organization for good in wildlife restoration and conservation is almost beyond comprehension.

The American Wildlife Institute is urging the active cooperation of American industry in the restoration of American wildlife. Upon the nation's wildlife was built the first great business of the country, the fur trade. No less today is American business as a whole concerned with the welfare of wildlife. To tell this story to industry a brochure has recently been published under the title "The Dollar in the Duck". Copies are available upon request.

DYNAMITE AS A TOOL TO BE SELECTED WITH A VIEW TO THE PARTICULAR KIND OF FARM WORK TO BE DONE

EDITOR'S NOTE:- While many farmers are informed as to the use of dynamite for various purposes in agriculture, comparatively few users of explosives are sufficiently familiar with the types and strengths to use for different kinds of blasting. With that fact in mind, Mr. Livingston has prepared this article. Those in contact with farmers and who may desire to make use of the data by reprinting or otherwise are at liberty to do so.

By L. F. Livingston, Manager,
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It has been pointed out that to appreciate the importance and the great utility of dynamite, the user should look upon the explosive as a tool, capable of doing useful work, when properly handled.

In order to develop the idea further, comparison can be made with another and one of the most useful of tools -- the shovel. To many people, a shovel is just a shovel. But to the users of shovels, the job to be done determines the kind of shovel which will best do the work, be the shovel long or short handled, round or square pointed, scoop or spade. Then, having chosen the right sort of shovel, it must be handled according to good practice, if efficiency and economy are to be effected in its use.

To those unfamiliar with dynamites and their uses, they are simply explosives that "go off" and a few sticks would destroy "an entire city block," as too often newspapers tell the public when the police discover a small lot of dynamite, purloined from a quarry or elsewhere. On the other hand, many users of explosives for agricultural purposes, although they recognize the usefulness of explosives, are little informed as to kinds and strengths.

Essentials of Successful Blasting

Success in blasting is dependent primarily on two factors. They are (1) the use of the type and strength of explosive best adapted to a particular kind of blasting and (2) proper loading. It is not, however, to discuss here the loading of blasts. But, for the ready reference of agricultural engineers, county agents and others who are called upon to advise farmers as to stump shooting, boulder blasting, ditching and other farm uses of dynamite, there is presented data on explosives and their several uses.

As a further matter of information, there is a chart showing the kinds of

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explosives commonly used for such industrial purposes as coal and metal mining, highway and other construction, and other uses. Certain of these types of explosive are also used for agricultural blasting, as will be seen by comparing the industrial explosives chart and the listing for farm purposes.

BRANDS OF DU PONT EXPLOSIVES AND THEIR AGRICULTURAL USES

CLASS OF WORK	EXPLOSIVES RECOMMENDED IN ORDER OF PREFERENCE 1	2	3
BOULDERS... Block Holes	...DuPont Extra D-H.	Red Cross 20-40%	Agritol No. 2
Mud Caps	...Straight 40-60%	Red Cross 40-60%	Agritol No. 2
Snake Holes	..Gelatin 40-60%	Red Cross 40-60%	Agritol No. 2
Concrete & Masonry...	Red Cross 40%	Gelex 2	Agritol No. 2
Ditching....Wet	Ditching Dynamite		
Dry	Red Cross 60%	-	-
Cellar Excavation.....	Spec.Gel.30-60%	Gelex 2	Agritol No.2
Gullies	Red Cross Blasting 2 - DuP Extra H		-
Ice Blasting.....	Gelatin 40%	Straight 40%	Gelex 2
Ponds (Digging & Cleaning)....	Ditching Dyn. -	Red Cross Extra 60% -	Gelatin
Post Holes.....	DuPont Extra D.	Red Cross 40%	- Gelatin 40%
Stump Blasting.....	Agritol and Agritol No.2. -	Red Cross 20-40%	- Stumping Pdrs.
Subsoil Blasting....	DuP.Extra D-H -	Red Cross Extra 20-40%	- Agritol.
Tree Planting.....	DuP. Extra D-H -	Red Cross Extra 20-40%	- Agritol

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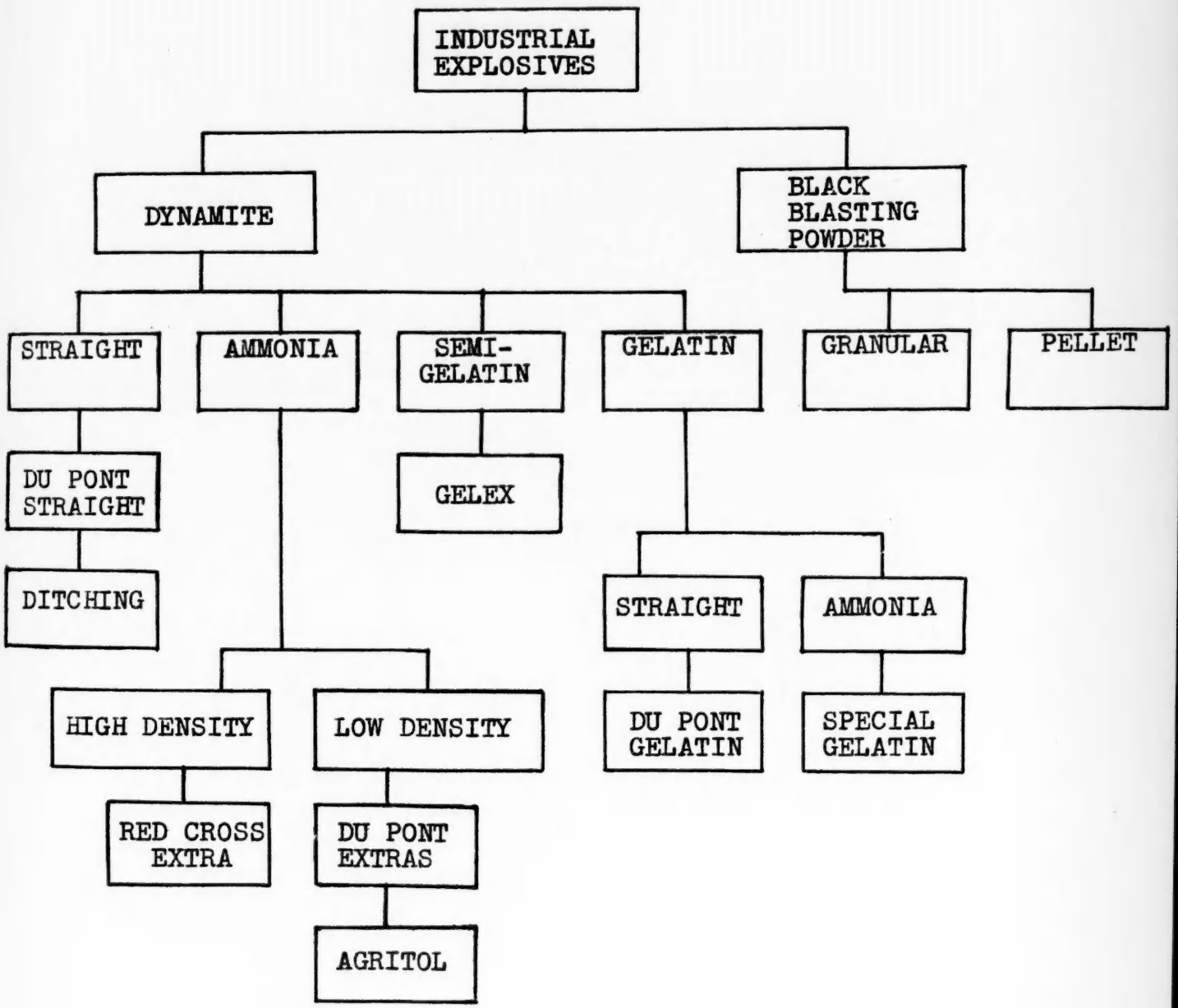
PRINCIPAL KINDS OF DU PONT INDUSTRIAL EXPLOSIVES